alliance, or for some other purpose. If the Amazons are, as is commonly thought, merely legendary persons, having no real existence, this sculpture at Boghaz-Keui may yet be looked upon with probability as tending to show that, in what may be called their own country, the story of these female warriors was believed. On the whole, it seems likely, in view of the evidence of this bas-relief, that the story rests on a substantial basis of truth. There is also, I may add, in the Hamath inscriptions, what looks very much indeed like the indication of female warriors armed with club and sword.[1]

Before passing from this Boghaz-Keui sculpture (other interesting bas-reliefs which are there I cannot now discuss), I must refer to the fact that in several instances curious symbols are held in the hands of several of the personages in the processions, or are placed near them. The floral or vegetable symbols held in the hands of the principal personages are surmounted by a remarkable oval figure. This oval object Prof. Sayce regards as a symbol of deity; and the vegetable or other figure beneath he takes for the name of a god. That the name of a god could be indicated by characters such as these seems to me a thing not easily credible; and the inscriptions give very strong reasons for regarding the oval object as a symbol denoting, not deity, but a city.[2] The more probable view seems to be that these figures surmounted by the oval object are the distinctive standards of cities. Unfortunately in the places where these standards occur the sculptures have suffered much from the effects of weather and of time; and the question has been complicated by the differences in the representations given by M. Texier and by MM. Perrot and Guillaume. The representations of the latter, based to a great extent on photographs, are no doubt by far the more accurate. M. Perrot seems to have thought that all these symbols are related to the mandragora or mandrake, a view which I venture to think very improbable. The oval symbol, with its curious marking, is certainly not the fruit of the mandrake, which is round and pendent, not oval and erect. But there is one place in the grand tableau where, I should say, the mandrake is clearly intended.[3] One of these is the symbol borne by the male figure immediately behind what I may call the queen. This figure bears in his hand, as a standard, the mandrake root with the ends turned up into feet. The ancients not only attributed aphrodisiacal and fecundating properties to the mandrake-root, but they also considered that it resembled the body of a man. Pythagoras is said to have spoken of the mandrake as "of human shape." And the difficulty about the feet was easily got over by a little manipulation.[1] There may possibly be some connection between this single male figure with the mandrake standard behind the queen, and what was said by the Greeks as to the relations of the Amazons with the males of a certain city separated from them by a mountain. I should add that the male figure immediately behind the king has the pole of the standard and the oval above, but the intervening figure is gone. It is probably still the standard-pole with the last figure to the reader's left in the central tableau. And possibly, too, at Karabel, the Hittite characters are to be understood as depicted on a standard.

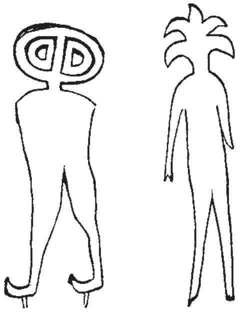

FIG. C.—1. Standard, with symbol of "city" at Boghaz-Keui. 2. Mandrake after Visconti ("Iconographie Grecque") from manuscript of Dioscorides.

(*To be continued.*)

TIMBER, AND SOME OF ITS DISEASES.[2]

VI.

IF we turn our attention for a moment to the illustrations in the first article, it will be remembered that our typical log of timber was clothed in a sort of jacket termed the cortex, the outer parts of which constitute what is generally known as the bark. This cortical covering is separated from the wood proper by the cambium, and I pointed out (p. 184) that the cells produced by divisions on the outside of the cambium cylinder are employed to add to the cortex.

Now this cortical jacket is a very complicated structure, since it not only consists of numerous elements, differing in different trees, but it also undergoes some very curious changes as the plant grows up into a tree. It is beyond the purpose of these articles to enter in detail into these anatomical matters, however; and I must refer the reader to special text-books for them, simply contenting myself here with general truths which will serve to render clearer certain statements which are to follow.

It is possible to make two generalizations, which apply not only to the illustration (Fig. 20) here selected, but also to most of our timber-trees. In the first place, the cortical jacket, taken as a whole, consists not of rigid lignified elements such as the tracheids and fibres of the wood, but of thin-walled, soft, elastic elements of various kinds, which are easily compressed or displaced, and for the most part easily killed or injured—I say for the most part easily injured, because, as we shall see immediately, a reservation must be made in favour of the outermost tissue, or cork and bark proper, which is by no means so easily destroyed, and acts as a protection to the rest.

The second generalization is, that since the cambium adds new elements to the cortex on the inside of the latter, and since the cambium cylinder as a whole is travelling radially outwards—*i.e.* further from the pith—each year, as follows from its mode of adding the new annual rings of wood on to the exterior of the older ones, it is clear that the cortical jacket as a whole must suffer distension from within, and tend to become too small for the enlarging cylinder of rigid wood and growing cambium combined. Indeed, it is not difficult to see that, unless certain provisions are made for keeping up the continuity of the cortical tissues, they must give way under the pressure from within. As we shall see, such a catastrophe is in part prevented by a very peculiar and efficient process.

Before we can understand this, however, we must take a glance at the structural characters of the whole of this jacket (Fig. 20). While the branch or stem is still young, it may be conveniently considered as consisting of three chief parts.

(1) On the outside is a thin layer of flat, tabular cork-cells (Fig. 20, *Co*), which increase in number by the activity

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[1] Under an indication of sex scarcely to be mistaken, is an arm with a hand grasping a club and a sword or dagger.

[2] This was, I believe, the view of Prof. Sayce, before he recognized the Hittite character of the Boghaz-Keui sculptures.

[3] There is evidence also equally clear on the other bas-reliefs at Boghaz-Keui which I do not here discuss.

[1] In the drawing in a manuscript of Dioscorides, of the fifth century, in the library of Vienna, and in Visconti's engraving, the mandrake root is grasped by a female figure. An artist, who is painting the mandrake, is actually accentuating the feet.

[2] Continued from p. 279.

of certain layers of cells along a plane parallel to the surface of the stem or branch. These cells (*C.Ca*) behave very much like the proper cambium, only the cells divided off from them do not undergo the profound changes suffered by those which are to become elements of the wood and inner cortex. The cells formed on the outside of the line *C.Ca* in fact simply become cork-cells; while those formed on the inside of the line *C.Ca* become living cells (*Cl*) very like those I am now going to describe.

(2) Inside this cork-forming layer is a mass of soft, thin-walled, "juicy" cells, *pa*, which are all living, and most of which contain granules of chlorophyll, and thus give the green colour to the young cortex—a colour which becomes toned down to various shades of olive, gray, brown, &c., as the layers of cork increase with the age of the part. It is because the corky layers are becoming thicker that the twig passes from green to gray or brown as it grows older. Now these green living cells of the cortex are very important for our purpose, because, since they contain much food-material and soft juicy contents of just the kind to nourish a parasitic fungus, we shall find that, whenever they are exposed by injury, &c., they constitute an important place of weakness—nay, more, various fungi are adapted in most peculiar ways to get at them. Since these cells are for the most part living, and capable of dividing, also, we have to consider the part they play in increasing the extent of the cortex.

(3) The third of the partly natural, partly arbitrary portions into which we are dividing the cortical jacket is found between the green, succulent cells (*pa*) of the cortex proper (which we have just been considering), and the proper cambium, *Ca*, and it may be regarded as entirely formed directly from the cambium-cells. These latter, developed in smaller numbers on the outside, towards the cortex, than on the inside, towards the wood, undergo somewhat similar changes in shape to those which go to add to the wood, but they show the important differences that their walls remain unlignified, and for the most part very thin and yielding, and retain their living contents. For the rest, we may neglect details and refer to the illustration for further particulars. The tissue in question is marked by *S*, *c*, *hb* in the figure, and is called *phloem* or bast.

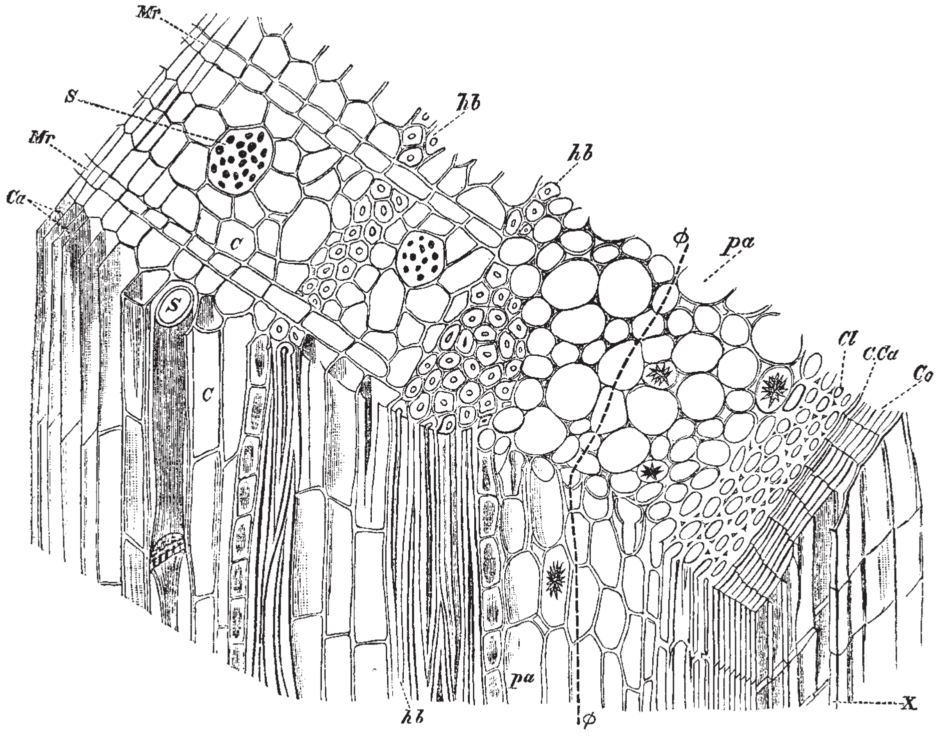

FIG. 20.—A piece of the cambium and cortical jacket of a young oak, at the end of the first year. It may be regarded as consisting of three parts, in addition to the cambium (*Ca*). Beginning from the outside, we have: (1) cork-cells (*X*), formed from the cork-cambium (*C.Ca*): the cells developed on the inside of the latter (*Cl*) are termed collenchyma, and go to add to the cortex. (2) The cortex proper, consisting of parenchyma-cells (*pa*), some of which contain crystals. (3) The inner or secondary cortex (termed *phloem* or bast), developed chiefly by the activity of the cambium (*Ca*): this phloem consists of hard bast fibres (*hb*), sieve-tubes (*S*), and cells (*c*), and is added to internally by the cambium (*Ca*) each year. It is also traversed by medullary-rays (*Mr*), which are continuations of those in the wood. The dotted line (φ) in the cortical parenchyma indicates where the new cork-cambium will be developed: when this is formed, all the tissues (e.g. *pa*, *Cl*), lying on the outside of the new cork will die, and constitute (together with the cork) the true *bark*.

A word or two as to the functions of the cortex, though the subject properly demands much longer discussion. It may be looked upon as especially the part through which the valuable substances formed in the leaves are passing in various directions to be used where they are wanted. When we reflect that these substances are the foods from which everything in the tree—new cambium, new roots, buds, flowers, and fruit, &c.—are to be constructed, it becomes clear that if any enemy settles in the cortex and robs it of these substances, it reduces not only the general powers of the tree, but also—and this is the point which especially interests us now—its timber-producing capacity. In the same way, anything which cuts or injures the continuity of the cortical layers results in diverting the nutritive substances into other channels. A very large class of phenomena can be explained if these points are understood, which would be mysterious, or at least obscure, otherwise.

Having now sketched the condition of this cortical jacket when the branch or stem is still young, it will be easy to see broadly what occurs as it thickens with age.

In the first place, it is clear that the continuous sheet of cork (*Co*) must first be extended, and finally ruptured, by the pressure exerted from within: it is true, this layer is very elastic and extensible, and impervious to water or nearly so—in fact it is a thin layer or skin, with properties like those of a bottle cork—but even it must give way as the cylinder goes on expanding, and it cracks and peels off. This would expose the delicate tissues below, if it were not for the fact that another layer of cork has by this time begun to form below the one which is ruptured: a cork-forming layer arises along the line *ϕ*, and busily produces another sheet of this protective tissue in a plane more or less exactly parallel with the one which is becoming cracked. This new cork-forming tissue behaves as before: the outer cells become cork, the inner ones add to the green succulent parenchyma-cells (*pa*). As years go on, and this layer in its turn splits and peels, others are formed further inwards, and if it is remembered that a layer of cork is particularly impervious to water and air, it is easy to understand that each successive sheet of cork cuts off all the tissues on its exterior from participation in the life processes of the plant: consequently we have a gradually increasing *bark* proper, formed of the accumulated cork-layers and other dead tissues.

A great number of interesting points, important in their proper connections, must be passed over here. Some of these refer to the anatomy of the various "barks"—the word "bark" being commonly used in commerce to mean the whole of the cortical jacket—the places of origin of the cork-layer, and the way in which the true bark peels off: those further interested here may compare the plane, the birch, the Scotch pine, and the elm, for instance, with the oak. Other facts have reference to the chemical and other substances found in the cells of the cortex, and which make "barks" of value commercially. I need only quote the alkaloids in Cinchona, the fibres in the Malvaceæ, the tannin in the oaks, the colouring-matter in *Garcinia* (gamboge), the gutta-percha from *Isonandra*, the ethereal oil of cinnamon, as a few examples in this connection, since our immediate subject does not admit of a detailed treatment of these extremely interesting matters.

The above brief account may suffice to give a general idea of what the cortical jacket covering our timber is, and how it comes about that in the normal case the thickening of the cylinder is rendered possible without exposing the cambium and other delicate tissues: it may also serve to show why bark is so various in composition and other characters. But it is also clear that this jacket of coherent bark, bound together by the elastic sheets of cork, must exert considerable pressure as it reacts on the softer, living, succulent parts of the cortex, trapped as they are between the rigid wood cylinder and the bark; and it is easy to convince ourselves that such is the case. By simply cutting a longitudinal slit through the cortex, down to near the cambium, but taking care not to injure the latter, the following results may be obtained. First, the bark gapes, the raw edges of the wound separating and exposing the tissues below; next, in course of time the raw edges are seen to be healed over with cork—produced by the conversion of the outer cells into cork-cells. As time passes, provided no external interference occurs, the now rounded and somewhat swollen cork-covered edges of the wound will be found closing up again; and sooner or later, depending chiefly on the extent of the wound and the vigour of the tree, the growing lips of the wound will come together and unite completely.

But examination will show that although such a slit-wound is so easily healed over, it has had an effect on the wood. Supposing it has required three years to heal over, it will be found that the new annual rings of wood are a little thicker just below the slit; this is simply because the slit had released the pressure on the cambium. The converse has also been proved to be true—*i.e.* by increasing the pressure on the cambium by means of iron bands, the annual rings below the bands are thinner and denser than elsewhere.

But we have also seen that the cambium is not the only living tissue below the bark: the cortical parenchyma (*pa*), and the cells (*c*) of the inner cortex (technically the phloem) are all living and capable of growth and division, as was described above. The release from pressure affects them also; in fact, the "callus," or cushion of tissue which starts from the lips of the wound and closes it over, simply consists of the rapidly growing and dividing cells of this cortex, *i.e.* the release from pressure enables them to more than catch up the enlarging layer of cortex around the wound.

An elegant and simple instance of this accelerated growth of the cortex and cambium when released from the pressure of other tissues is exhibited in the healing over of the cut ends of a branch, a subject to be dealt with later on; and the whole practice of propagation by slips or cuttings, the renewal of the "bark" of Cinchonas, and other economic processes, depend on these matters.

In anticipation of some points to be explained only if these phenomena are understood, I may simply remark here that, obviously, if some parasite attacks the growing lips of the "callus" as it is trying to cover up the wound, or if the cambium is injured below, the pathological disturbances thus introduced will modify the result: the importance of this will appear when we come to examine certain disturbances which depend upon the attacks of Fungi which settle on these wounds before they are properly healed over. In concluding this brief sketch of a large subject, it may be noted that, generally speaking, what has been stated of branches, &c., is also true of roots; and it is easy to see how the nibbling or gnawing of small animals, the pecking of birds, abrasions, and numerous other things, are so many causes of such wounds in the forest. H. MARSHALL WARD.

(*To be continued.*)

NOTES.

On Friday, the 23rd inst., Sir Henry Roscoe drew attention in the House of Commons to the Woolwich regulations, the mischievous nature of which we have repeatedly exposed. Sir Henry Roscoe was cordially supported by Sir Lyon Playfair; and Mr. Stanhope, we are glad to say, dealt with the subject in a fair and conciliatory spirit. He promised to discuss the matter with men of science, and the result, we may hope, will be that new regulations will soon be drawn up, securing that scientific candidates shall not be placed at a disadvantage as compared with students of language and literature.

In replying to Sir Henry Roscoe, Mr. Stanhope made a statement to the effect that the regulations now in force for Sandhurst, which were issued in 1884, were recommended by upwards of fifty head masters. We have before us the Report of the Head Masters' Conference for 1883, in which the recommendations of their Committee are printed, and these recommendations differ in certain important respects from the regulations actually adopted by the War Office. The head masters appear, from their suggestions, to have desired to retain a more important place for Latin and Greek than those subjects occupy in the War Office regulations; and they also attached a higher value to higher mathematics. On the other hand, they placed modern languages and experimental science on a lower but relatively less unequal footing than the War Office has done. Although, therefore, in consequence of the position of classics, the actual value of science was, on the whole, perhaps not better under the head masters' suggestions than under the regulations issued by the War Office, it is hardly correct to speak of the head masters as having recommended a scheme of which the predominating fault is, as